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DATA ON TECHNOLOGICAL DEVELOPMENTS AND PLANTS OF THE SOVIET ZONE IRON AND STEEL INDUSTRY

/Part I of this report gives information on technological development and raw material requirements at certain Soviet Zone steel plants as reported at a meeting of plant representatives. Parts II, III, and IV give data on the projected Brandenburg Steel Plant./

I. TECHNOLOGICAL DEVELOPMENTS AND RAW MATERIAL REQUIREMENTS

A meeting to discuss technological experience, attended by representatives of steel plants in the German Democratic Republic was held in Berlin on 2 March 1950. The following organizations were represented: Ministry of Industry, including the Main Departments for Metallurgy, Machine Construction and Electrical Engineering, and Science and Technology; Ministry of Planning; Soviet Control Commission; Board of Directors of the Metals Combine; Vesta, Gus, and Brandenburg Federations of people-owned enterprises; Central Construction Bureau, Hennigsdorf and Riesa steel and rolling mills; Maxhuette; Groeditz and Leipzig iron and steel works; Doehlen Foundry; Leipzig Steel and Casting Plant; Leipzig-West Electric Steel Foundry; Olbersdorf Steel Plant; Ketschendorf; Krautheim/Chemnitz; Silbitz Furnace Plant, Thale Foundry, and Krupp-Gruson Soviet corporations; Technical Bureau; Iron Research Institute; Metallurgy Institute of the Freiberg School of Mining; Government of Land Sachsen. The director of the meeting was Dr-Engr Kraemer, Main Department for Metallurgy.

The first report concerned the improvement of work methods and metallurgical technology at the Hennigsdorf Steel and Rolling Mill.

Dr-Engr Kuentscher, technical director of the Hennigsdorf plant, discussed the development of the scrap metal-carbon process. Coal-charging hoppers which were installed in the plant made possible a uniform distribution of coal over the scrap. A previous attempt had been made in various steel plants to improve the distribution of coal by using a scoop, but this method was dropped because it was

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too cumbersome. Dr Kuentscher stated that an important advantage in distributing coal in the furnace was that the gas did not have to be turned off; thus, the danger of fusion on the roof was substantially lessened. The process was still further developed by mixing a part of the lime with the coal and adding it in this combined form. By this method, the Hennigsdorf plant has reduced the amount of time required for charging.

The Steinheisser trough used in the Hennigsdorf plant was then described. A two-ladle tapping was formerly performed in this plant by using a tilting trough, the same method used for decades in other plants. In this method the two ladles were adjacent, and were alternately fed with steel by a tilting trough. With the Steinheisser trough, the steel is fed across the ladle which is directly next to the furnace but somewhat lower, into the second ladle. The early fears that this process would entail too-rapid cooling of the steel, and thus impair the quality, proved unwarranted. It was verified that besides the advantages of improved working techniques through this clean and simple operation, and the low limestone consumption, there are also surprising improvements in quality. The proportions of phosphorus and sulfur are better in several respects, over an average of several hundred charges. The number of ingots subject to flaws while being rolled on the blooming mill is notable less.

In continuation of the work of Dr Kuentscher and Professor Erdmann-Jesnitzer on the after-treatment of steel with carbon, the Steinheisser trough was further developed by adding to the process an additional treatment with carbon. Electrode carbon is inserted in the trough, and further treats the steel through direct reduction, the formation of protective gasses, and the stripping effect on the slag. Steel processed in this way has, in addition to the basic advantages of the trough steel already mentioned, the advantage of notably greater longevity. Test results proved this.

It was decided at the meeting that experiments on the scrap metal-carbon process should be conducted, and the following plants were given the responsibility for undertaking projects:

1. In an electric furnace at the Maxhuette Plant, which has a very long trough at its disposal, an experiment is to be conducted with a closed trough partially lined with carbon.

2. In a Siemens-Martin furnace at the Riesa steel plant, an experiment is to be performed with a closed trough partially lined with carbon. In view of special conditions at the Riesa plant it is not necessary for this trough to be a tapping trough.

3. The Hennigsdorf Steel and Rolling Mill, and specifically Dr Kuentscher and Dr-Engr Steinheisser, were assigned to make sketches or diagrams of proposals demonstrating the construction of the trough for the above-named plants.

4. The Riesa Steel and Rolling Mill was assigned to perform experiments on the uniform distribution of coal and lime over the scrap by means of a coal-charging hopper. The goal is to reduce the amount of time required for charging and for finishing operations, and in this way to reduce manganese requirements. Moreover, this is to result not only in an improvement in the chemical analysis but also in improvement in the ultimate stress values of the charge.

Reference was then made to the operations of the Hennigsdorf Rolling Mill Collective, which has produced rolls with increased wear resistance. By using a special electrode, Hennigsdorf has succeeded in increasing the wear of the rolls by one third to one fourth. A new welding technique, which is still being developed, was mentioned, and it was decided that this would be reported on at the rolling mill conference to be held at the Ministry of Industry.

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Gau, foundry superintendent at the Hennigsdorf plant, then reported on the improvement of the elongation values and notch impact strength of cast steel by special thermal treatment. He discussed the results of rapid annealing in comparison with normalizing annealing. Gau stated that the removal of pieces from the furnace brought good results if rapid annealing was properly timed. The annealing process which follows rapid annealing was subjected to more detailed study at Hennigsdorf. In cases where the quality of the material was not satisfactory, an annealing process alternating between 650 and 730 degrees was used; it resulted in a marked increase in elongation values. Experimental annealing processes by which the rapid air-annealing process was combined with steam cooling were also carried out. The main purpose of these experiments was to determine the system to be used in the annealing section of the Hennigsdorf plant. This system was described as follows: The material is conveyed in furnace carts, each 7 meters long, to a continuous annealing furnace, 28 meters long. The carts are drawn out of this continuous-heating furnace at fixed time intervals, and are then exposed to rapid air cooling. After this, they are transported to the corresponding tempering furnaces. Gau explained that the advantage of such a process is that the continuous-heating furnace can be evenly heated throughout by continuous, uniform timing of firing and with low fuel consumption, while sparing the refractory material. It eliminates the problem of the entire furnace area constantly cooling off and having to be raised to high temperatures again. He stated that the tempering furnaces likewise require only a little additional heating.

The second major topic brought before the meeting was the development of the requirement figures and coefficients for raw materials and auxiliary materials for the various steel plants in the German Democratic Republic. Dr-Engr Baake, from the Vesta Federation of People-Owned Enterprises in Leipzig, reported on the efficiency of the various plants, and a general discussion followed. The following points were brought out:

The most important coefficient in a steel plant is the hearth-area efficiency in kilograms per square meter per hour, because it indicates the operational efficiency and degree of utilization of the actual furnace capacity. An output of 200 kilograms per square meter per hour is considered a normal coefficient for Siemens-Martin plants. Since the large Vesta, Riesa, and Hennigsdorf plants have outputs of only about 140-150 kilograms per square meter per hour, their production can be substantially increased. In fact, an increase in this output must be achieved to realize the 1950 plan. Only by increasing the hearth-area efficiency to about 180 kilograms per square meter per hour will the Riesa and Hennigsdorf plants be able to accomplish their year plans. Furnace capacity constitutes no obstacle to attaining this additional output. Only the conveying installations and the casting pits, which are too narrow, are inadequate. It is important that these bottlenecks be eliminated in the steel plants. These are the most important investments which, with limited means, can result in the production of greater quantities of steel. Actually, the hearth-area efficiency, particularly at Thale, Crossen, and Magdeburg, is substantially higher than in the large Vesta plants. In the former plants it is about 200 kilograms per square meter per hour, and even considerably higher at Crossen. The situation is bad at Groeditz, where the hearth-area efficiency is still under 100 kilograms per square meter per hour. The poor performance can be attributed only partially to the casting pits and to the supply of scrap. The main defect is the method of operation, which is not yet correctly organized. Therefore, the task of the Groeditz plant must be, as soon as possible, to check the entire process thoroughly by pyrometrical and metallurgical tests, and to take adequate corrective measures.

The general coefficient for the consumption of refractory materials is 13 kilograms per ton of steel. The materials used are silica brick, firebrick, and magnesite brick. The consumption in East German plants is substantially

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higher; in the Riesa and Hennigsdorf plants it amounts to about 30 kilograms per ton of steel. It is clear that the quality of the refractory materials still leaves much to be desired, and efforts are constantly being made to improve it. However, it also stated that not only the quality of the materials, but to an even greater extent the handling of materials in the plants explains the poor consumption figures. The importance of protecting the refractory materials from moisture is well known; yet silica bricks can always be seen stored in the open along the roads at the plants. If even a few bricks do not meet the requirements, this is enough to bring about the collapse of the entire roof of a furnace.

Consumption of lime in the Riesa plant is conspicuously high. It amounts to 55-60 kilograms per ton of steel, which is considerably higher than in the other plants. The Riesa plant was requested to reduce the consumption to a maximum of 50 kilograms of lime per ton of steel.

The consumption of dolomite in the Hennigsdorf plant is unusually high, amounting to 55 kilograms per ton of steel; in the Riesa plant, consumption is 48 kilograms per ton; and in the Maxhuette electric furnaces, 45 kilograms per ton. In other plants, such as Thale and Magdeburg, dolomite consumption amounts to less than 30 kilograms per ton of steel. Economy in this matter is of particular importance at present, because dolomites constitute a serious bottleneck. The plant managers should see to it that the dolomite is thoroughly fused and that it does not pass into the slag. It was proposed that a dolomite consumption of 40 kilograms per ton of steel be designated as the highest amount permissible.

The consumption of briquettes amounts to about 410 kilograms per ton in the Riesa plant, 500 at Hennigsdorf, and 800 at Groeditz. The East German plants must set as their goal a consumption of 400 kilograms per ton, a figure which the Riesa plant will probably achieve soon. The Hennigsdorf plant will undoubtedly follow, but in the Groeditz plant special efforts in all furnace operations are necessary to attain this goal.

In regard to heat consumption, it was pointed out that the long charging periods denote an exceptional heat loss, and it was suggested, in this connection, that the carburization experiments soon to begin in the Riesa plant be followed with interest.

Consumption of molds in well-organized steel plants normally amounts to 12 kilograms per ton of steel. East German plants generally use twice this amount, mainly because of neglect in the care of the molds. It was pointed out that molds should be heated before the first casting, but that this procedure is not followed in any of the plants. This is not justified by the fact that the molds are often reused while still hot. It was suggested that a maximum consumption of 18 kilograms per ton be prescribed as the absolute limit for the individual plants.

As for the consumption of manganese, varying conditions prevail in the individual plants. The Hennigsdorf plant has taken the lead, and has lowered its manganese consumption to 1.8 kilograms of pure manganese per ton of steel (pertains to steel which is not combined with manganese to form alloy steel). The Riesa and Groeditz plants were requested to use the same smelting methods as the Hennigsdorf plant and to reduce manganese consumption accordingly. It was proposed that 2.5 kilograms of manganese per ton be specified as the absolute maximum consumption for the plants.

The following figures were established as obligatory for the plants and as the absolute minimum goals to be reached in the second quarter.

	Kg per Ton of Steel
Refractory materials	13
Dolomite	40
Briquettes	400
Lime	50
Molds	20
Manganese	3
Hearth-area efficiency	180 kg per sq m per hr

II. CONSTRUCTION OF BRANDENBURG STEEL PLANT

On 7 February 1950, the Central Construction Bureau released a report giving the following information on construction plans for the Brandenburg Steel Plant.

A new steel plant is to be constructed in Brandenburg, its primary task is to furnish raw steel to plants which have no Siemens-Martin installations of their own. The capacity of this new Siemens-Martin steel plant is to be 500,000 tons of raw steel per year, to be produced by ten Siemens-Martin furnaces, each of 100-ton capacity. In addition, to cover the semifinished steel requirements of the rolling mills in Kirchmoeser, Burg, Olbernhau, Aue, Ilsenburg, etc., the new plant is to be equipped with a single-stand, 1,100, two-high reversing mill, with 2,800-millimeter-long rolls, and with a capacity of 500,000 tons per year, 200,000 tons of which are to be slabs; also a 750 plate-bar and billet rolling mill, with 2,250-millimeter-long rolls, and with a capacity of 300 [sic] tons per year. The project further includes the procurement of rolling equipment for the entire range of sizes, from thin sheet to thick plate.

Since the plant is to be such an exceptionally large-scale installation, it is to be built in sections. The first section is to be so constructed that a production of 40,000 tons of raw steel in ingots or slabs will be achieved before the end of 1950. To attain this production figure, installation of the following units is required by the deadline dates indicated:

1 August 1950

Steel plant building, consisting of an open area, 100 meters long, and of furnace area No 1, 300 meters long.

Siemens-Martin furnace No 1 with four generators; first charging crane; two casting cranes; two pit grabs and magnetic cranes; scrap yard II, with three areas for charging platforms, five areas for scrap loading, and lime and dolomite storage bunkers with bucket conveyers; wash and rest rooms; offices and testing laboratory; and the necessary auxiliary installations to put Siemens-Martin furnace No 1 into operation, such as machine and electric shop, railroad and loading platform installations with railroad yard, water supply and drainage installations, and power supply.

1 October 1950

Extension of the steel plant building to include furnace area No 2, to be 300 meters long; second group of four generators; shops; Siemens-Martin furnace No 2; second charging crane; enlargement of scrap yard II by four additional areas; extension of rail line, water supply and drainage installations, and power supply installations for Siemens-Martin furnace No 2.

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1 November 1950

Extension of steel plant building to include furnace area No 3, to be 300 meters long; third group of four generators; shops; Siemens-Martin furnace No 3; enlargement of scrap yard II by four additional areas; extension of rail line, water supply and drainage installations, and power installations for Siemens-Martin furnace No 3.

The beginning of operations of the additional furnaces and the necessary aggregates must take place according to the following plan: Siemens-Martin furnace No 4, 15 January 1951; No 5, 1 March 1951; No 6, 1 May 1951; No 7, 15 June 1951; No 8, 1 August 1951; No 9, 15 September 1951; and No 10, 1 November 1951.

The operational labor force which will be required when the plant is completed as planned will total 2,350 workers, including: steel plant -- 15 foremen, 45 section leaders, 435 skilled workers, and 315 laborers; blooming mill -- 3 foremen, 4 section leaders, 60 skilled workers, and 155 unskilled workers; workshops, etc. -- 15 foremen, 27 section leaders, 370 skilled workers, and 180 unskilled workers; construction detachment -- 2 foremen, 6 section leaders, 140 skilled workers, and 165 unskilled workers; fire department, guards, etc. -- 130 skilled workers and 270 unskilled workers.

III. POWER SUPPLY FOR BRANDENBURG STEEL PLANT

On 6 February 1950 a conference concerning the power supply for the Brandenburg Steel Plant was held in Berlin between Reisinger, of the Central Construction Bureau, and four representatives of the Central Power District.

The following power outputs were established as required by the plant, to prepare for a final capacity of 26,000 or 36,000 kilowatts:

First construction stage, end of 1950: about 2,000 kilowatts

Construction of steel plant and rolling mill, end of 1951: about 14,000 kilowatts

Electric furnace to be constructed later, end of 1952: about 12,500 kilowatts

Plate mills: about 10,000 kilowatts

Since the North Power District is to supply the power, it was directed that arrangements be made between the Central and North Power Districts to meet those requirements.

IV. EXPECTED PRODUCTION AND EQUIPMENT OF THE BRANDENBURG STEEL PLANT

On 2 February 1950 a conference was held in Dahlbruch to discuss production data and equipment to be installed in the Brandenburg Steel Plant. Participants in the conference were Klemens, technical director of the Central Construction Bureau, Wizenez, from the Main Department for Metallurgy of the Ministry of Industry, and two representatives from the Siemag Plant.

Anticipated production figures were established as follows:

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An annual production of 500,000 tons of Siemens-Martin steel is to be rolled into billets and plate bars. Ingots weighing 5 tons and with [illegible] sectional dimensions of about 530 x 600 x 2,000 millimeters are available. The billets are to be produced at the rate of 120,000 tons per year. About 180,000 tons of plate bars are to be produced annually, in dimensions of 250 x 6.5 millimeters; later they are to be 300 - 350 x 6.5 millimeters and thicker. About 200,000 tons of prerolled slabs and forged pieces are to be produced per year. The slabs are to be stripped behind the blooming mill. In addition, small ingots, of 600 kilograms maximum weight, are to be rolled into plate bars for the production of high-alloy transformer sheets with about 4.3-percent silicon content. The production of these plate bars will probably be small in relation to production as a whole. The Siemag representatives suggested that the following dimensions would be suitable for the small ingots: 250 centimeters square at top surface and 230 centimeters square at the base, weight 600 kilograms; or 300 centimeters square at the base and 270 centimeters square at top surface, weight 785 kilograms. These ingots would not, as would the 5-ton ingots, go into a soaking pit, but would have to be heated in a pusher-type furnace or gravity-discharge furnace.

The following installations were suggested as the most advantageous for the rolling mill project:

One two-high reversing blooming mill, 1,050 x 2,700 millimeters, with a drive motor having a switching moment of 300-350 meter-tons and a speed of 0 - $\pm$ 60 to $\pm$ 120 rpm. It was suggested that the mill be of these dimensions because later prerolled slabs one meter wide are to be rolled on it and used for rolling into medium plate. The Siemag representatives suggested that the tilting devices and shunting installations be arranged on this blooming mill so that the slabs could be rolled on edge.

One two-high reversing blooming mill, an intermediate blooming mill with the dimensions 800 x 2,200 millimeters. The switching moment of the drive motor is about 150-meter-tons, adjustable from 0 - $\pm$ 80 to $\pm$ 160 rpm. In contrast to the large blooming mill, which is equipped with an Ilgner System, the Siemag representatives considered it more practical for the intermediate blooming mill to have a grid-controlled converter. The drive motor for the main blooming mill will be a twin motor. Inquiries are to be made of the electrical firms whether the same type of motor, but with a higher basic speed, is possible for the intermediate blooming mill. Because of the installation of an intermediate blooming mill, the eight-stand, continuous billet and plate-bar rolling mill which was planned by Siemag is to be replaced by a four-stand billet and plate-bar rolling mill. An upsetting machine is to be placed in front of this four-stand billet rolling mill. Also, this mill can be supplemented by two additional stands in the future.

The following data was supplied by Siemag, as provisional and not binding, in regard to motors:

For the upsetting machine: one direct-current motor of about 200 horsepower, adjustable from 400-800 rpm.

For the four-stand, continuous rolling mill: either one drive motor of about 3,000-3,500 horsepower, adjustable from 300-600 rpm, or a direct motor drive. To be able to control each stand independently of the others, Siemag pointed out that, for reasons of rolling techniques, the direct motor drive is considerably more effective. This would mean four motors, each of 1,000 horsepower, adjustable from 400 to 600 rpm.

Originally, an open mill was planned behind the main blooming mill to handle this production. When the project is completed, tests will show whether it would be more advantageous to use an open rolling mill or the rolling mills described above for the anticipated production, which is probably still subject to increase. In this connection, the rolling of the plate bars with high silicon content into

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transformer sheets would particularly have to be borne in mind. How the planned rolling mill project can be operated without an intermediate rolling mill will be determined later. In arranging the rolling mills, it should be taken into consideration that medium plate rolling mills and sheet rolling mills are to be added later. The preliminary material for the medium plate and sheet rolling mills is to be supplied by the aforementioned rolling mills.

A bloom and slab shear is to be set up between the blooming mill and billet-rolling mill, by which blooms and slabs can be trimmed and cut into sections 400 centimeters square or 1,000 x 160 centimeters.

It was decided that all of the auxiliary equipment required for the installation, such as flying shears, stackers, etc., would be ordered from the Siemag plant, and that a list of all required electric main and auxiliary drive equipment, including their maximum output values, would be attached to the order. Electric parts are not to be supplied by Siemag. The order is to be set up so that as many parts as possible can be produced in the Eastern Zone according to Siemag blueprints.

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